Energy Sources for Contraction

1) Creatine phosphate and 2) Cellular respiration

- Creatine phosphate – stores energy that quickly converts ADP to ATP

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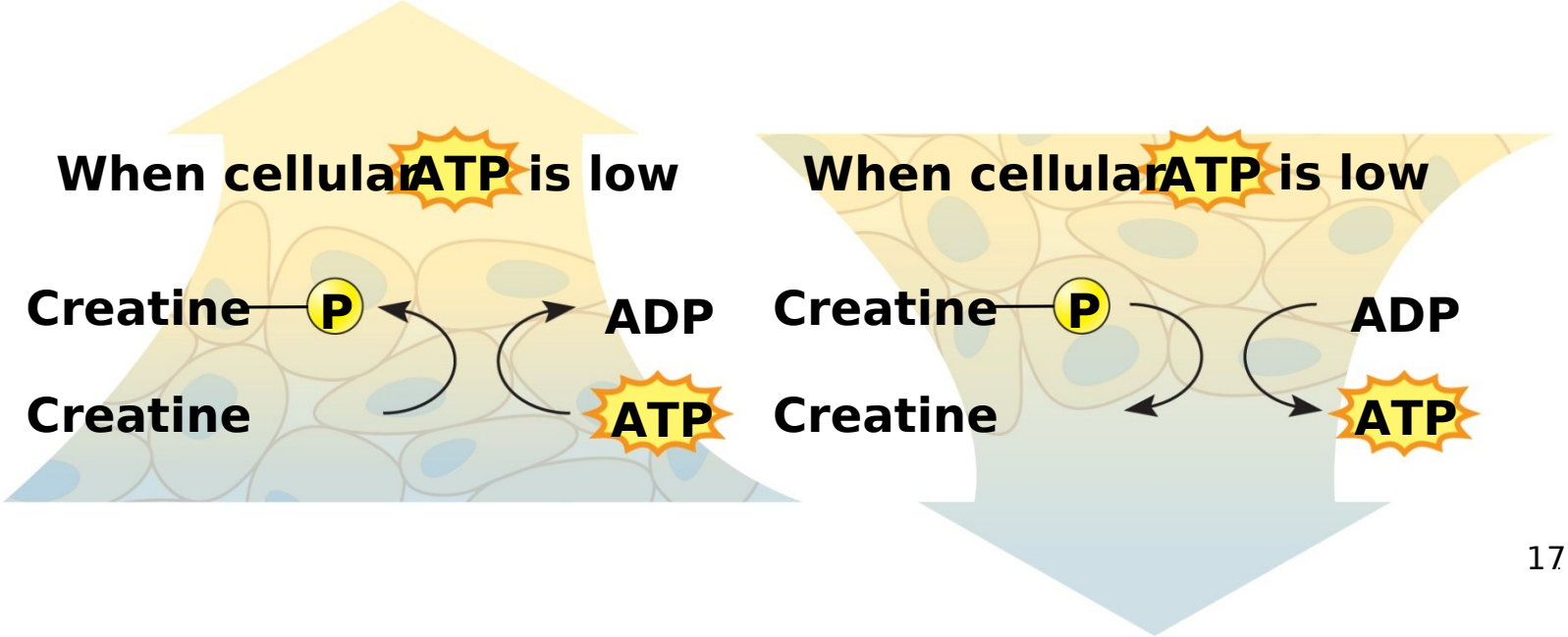
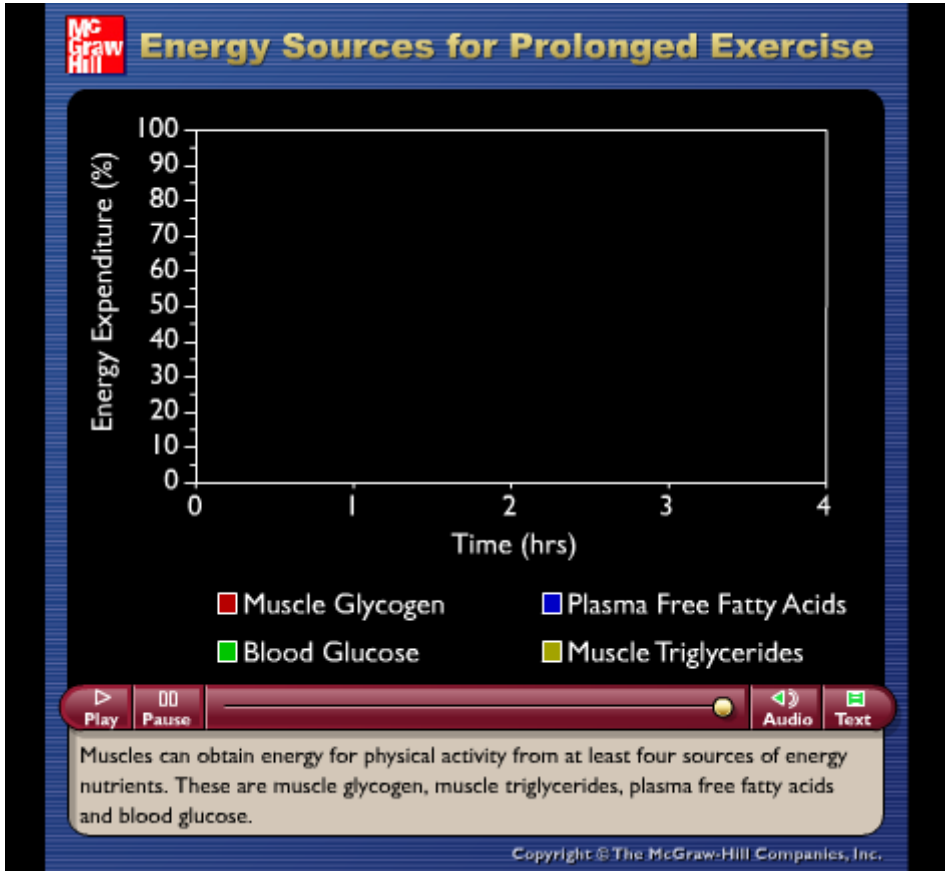


Animation: Energy Sources for Prolonged Exercise



Oxygen Supply and Cellular Respiration

- Cellular respiration:
  - Anaerobic Phase
    - Glycolysis
    - Occurs in cytoplasm
    - Produces little ATP
  - Aerobic Phase
    - Citric acid cycle
    - Electron transport syste
    - Occurs in the mitochonc
    - Produces most ATP
    - Myoglobin stores extra oxygen

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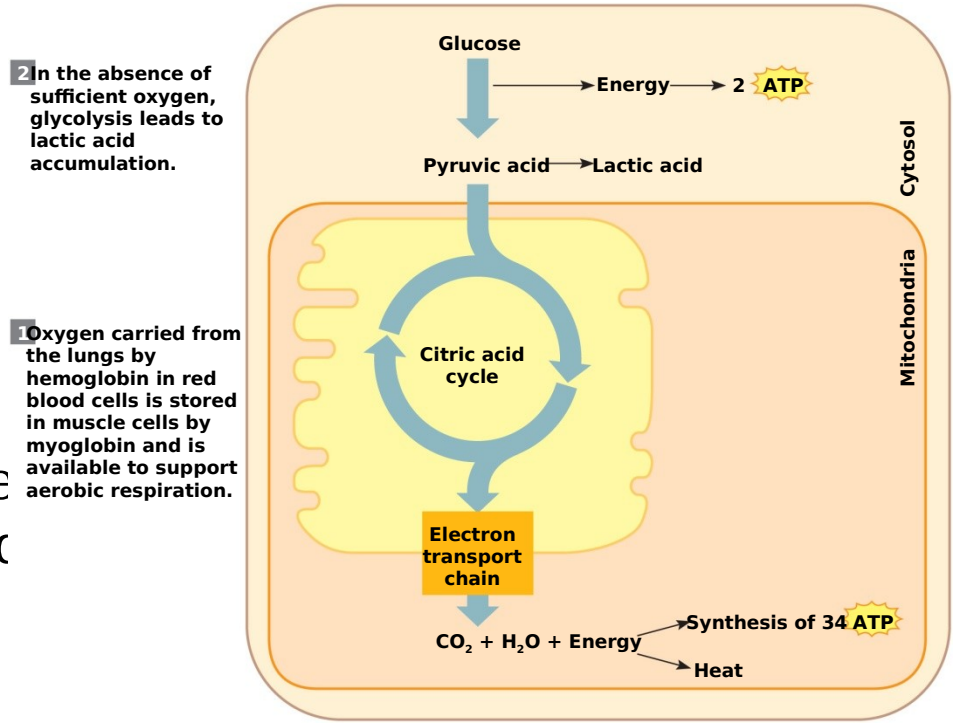
2 In the absence of sufficient oxygen, glycolysis leads to lactic acid accumulation.
1 Oxygen carried from the lungs by hemoglobin in red blood cells is stored in muscle cells by myoglobin and is available to support aerobic respiration.
Glucose
Energy
2 ATP
Pyruvic acid
Lactic acid
Cytosol
Mitochondria
Citric acid cycle
Electron transport chain
$CO_2 + H_2O$ + Energy
Synthesis of 34 ATP
Heat

Oxygen Debt

- Oxygen debt – amount of oxygen needed by liver cells to use the accumulated lactic acid to produce glucose
  - Oxygen not available
  - Glycolysis continues
  - Pyruvic acid converted to lactic acid
  - Liver converts lactic acid to glucose

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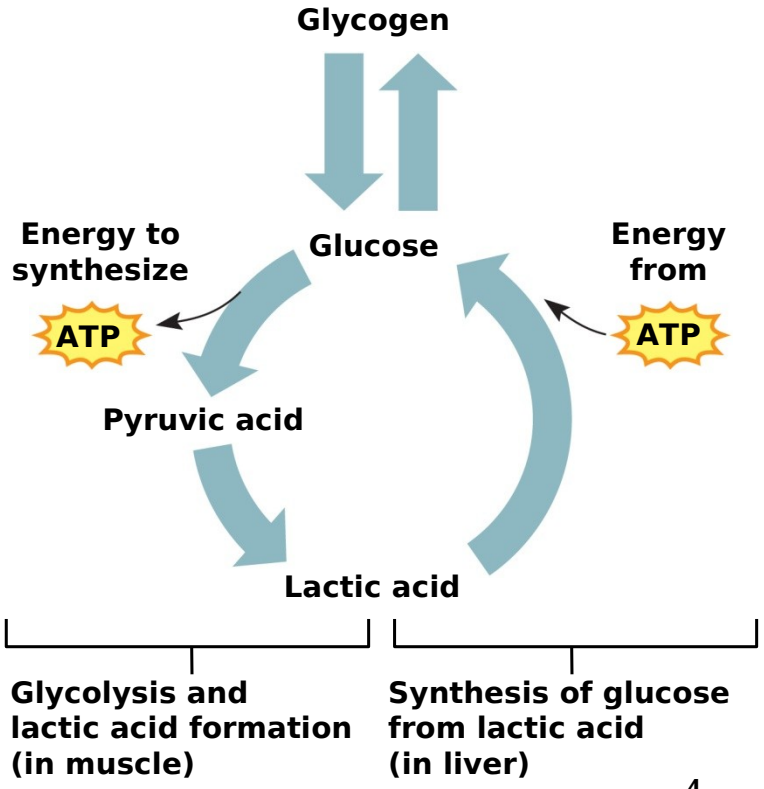

Muscle Fatigue

- Inability to contract muscle
- Commonly caused from:
  - Decreased blood flow
  - Ion imbalances across the sarcolemma
  - Accumulation of lactic acid
- Cramp – sustained, involuntary muscle contraction
- Physiological vs. psychological fatigue

Heat Production

- By-product of cellular respiration
- Muscle cells are major source of body heat
- Blood transports heat throughout body core